THE DIMENSIONALITY OF NATIONS PROJECT

RESEARCH REPORT

DEPARTMENT OF POLITICAL SCIENCE
UNIVERSITY OF HAWAII

The Dimensionality of Nations Project
Department of Political Science
University of Hawaii

RESEARCH REPORT NO. 43

Testing Field Theory on the 1963 Behavior Space of Nations

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Prepared For Presentation To The
Seventh European Peace Research Society (International) Conference
Rome, Italy, August 29-31, 1970

Prepared in connection with research supported by the Advanced Research Projects Agency, ARPA Order No. 1063, and monitored by the Office of Naval Research, Contract No. N00014-67-A-0387-0003.

Unclassified

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)
Dimensionality of Nations Project
University of Hawaii
2500 Campus Road, Honolulu, Hawaii 96822

2a. REPORT SECURITY CLASSIFICATION
unclassified

2b. GROUP

3 REPORT TITLE
"Testing Field Theory on the 1963 Behavior Space of Nations"

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)
Research Report No. 43

5 AUTHOR(S) (First name, middle initial, last name)
Richard Van Atta and R. J. Rummel

6 REPORT DATE
August, 1970

7a. TOTAL NO. OF PAGES
44

7b. NO. OF REFS
25

8a CONTRACT OR GRANT NO
N00014-67-A-0387-0003

b PROJECT NO

c.

d

9a. ORIGINATOR'S REPORT NUMBER(S)
Research report No. 43

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10 DISTRIBUTION STATEMENT
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11 SUPPLEMENTARY NOTES
2500 Campus Road
Honolulu, Hawaii 96822

12 SPONSORING MILITARY ACTIVITY
Advanced Research Projects Agency
Washington, D. C.

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The model interprets differences and similarities as implacable forces like gravity and centrifugal force which the nation cannot alter and which affect its behavior regardless of its history, culture, or other unique characteristics. A retest of this model for the same 182 pairs of nations used in the 1955 test showed that it has little value in accounting for behavior in general. All relationships between behavior and differences and similarities found for this model could have easily occurred by chance.

A second model interprets differences and similarities as general forces modified in their impact on behavior by the unique characteristics of each nation. A retest of this model was consistent with previous findings in showing an ability to explain around fifty percent of the variation in international behavior.

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
international conflict						
international behavior						
field theory						
canonical regression						
factor analysis						
national characteristics						

Testing Field Theory on the 1963 Behavior of Nations[1]

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ABSTRACT

A theory that the behavior of nations to one another is a result of their differences and similarities in attributes has been tested on 1955 data. This paper reports a retest of this theory on 1963 data.

One model interprets differences and similarities as implacable forces like gravity and centrifugal force which the nation cannot alter and which affect its behavior regardless of its history, culture, or other unique characteristics. A retest of this model for the same 132 pairs of nations used in the 1955 test showed that it has little value in accounting for behavior in general. All relationships between behavior and differences and similarities found for this model could have easily occurred by chance.

A second model interprets differences and similarities as general forces modified in their impact on behavior by the unique characteristics of each nation. A retest of this model was consistent with previous findings in showing an ability to explain around fifty percent of the variation in international behavior.

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[1]We are indebted to Warren Phillips for his many helpful comments on a previous draft.

TESTING FIELD THEORY ON THE 1963 BEHAVIOR OF NATIONS

I. FIELD THEORY

In "A Field Theory of Social Action with Application to Conflict Within Nations" (Rummel, 1965) a social field theory was presented which, after elaboration and some revision, was subjected to some initial tests (Rummel, 1969b). This paper presents the results of additional tests after some introductory comments on the theory itself. The initial field theory tests were run on data for 1955. The present analysis uses the same methodology to test the theory using 1963 data.

Social field theory has been presented in detail elsewhere (Rummel, 1965; 1969b), and will simply be summarized here. A field of social reality is posited, analytically distinguishing between the attributes of social units and their interactions. Attribute and behavior spaces are defined into which, respectively, attributes and interactions are projected as vectors. The distance vectors between social units on the dimensions of attribute space are seen as social forces determining the location of nation-pairs (dyads) on the dimensions of behavior space. The dynamic ramifications of field theory have been subjected to various interpretations (McCormick, 1969; Rummel, 1970b), but in its initial statement the direction and velocity of movement of a dyad over time is specified to be along the resolution of the attribute distance vectors.

The social field theory summarized above presents a particular view of social reality which differs in many respects from much of the theoretically oriented work in international relations. Even within the aggregate level of theorizing, field theory, as an overall interpretation of social reality, remains a relatively unique endeavor.[2] Since field theory specifies

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[2]A distinction is being made here between the aggregate and individual levels of theory. The aggregate level deals with relations, patterns, and regularities as defined by the variation of nations on their characteristics and behavior. The individual level of theory seeks to explain international

a comprehensive view of social reality it is somewhat difficult to compare it to less large scale efforts toward building international relations theory. There are a number of topics with which field theory and other theoretically oriented works might be compared and contrasted. The generality of the concepts and the nature of the empirical generalizations brought forth are two of the most salient topics we might discuss.

Field theory focuses on the relative distances of nations on attribute dimensions in explaining the behavior of nations. The theory postulates the existence of finite sets of attribute and behavior dimensions, and specifies the linkage between distances on attribute dimensions and the projection on the dimensions of behavior space. The substantive characteristics of the dimensions are not specified, nor is the combination of weightings of the attribute distances predicting specific dyadic behavior. In these respects, one might say that field theory is more abstract than most theoretical formulations of international relations.

Even at the aggregate level of theory in international relations, the usual focus is upon the relationship between specifically defined substantive variables. A number of studies have presented analyses of the relationships between such variables as power, development, integration, conflict, etc. For example, the hypothesized relationships of the various formulations of the balance of power theory take some measure of power as the independent variable to which is related some operational definition of conflict or stability as the dependent variable (Zinnes, 1967; Singer and Small, 1968). Organski's theory of power transition can be interpreted as positing an

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[2] (continued)

behavior as the result of a unique policy process for which the decision-makers are the primary units of analysis and both internal and international forces are analyzed as motivational elements for policy makers. A more elaborate discussion of this distinction is presented in Rummel (1970c).

increasing probability of conflict as the discrepancy in power between two major powers decreases (Organski, 1958). Theoretical formulations here predicted a wide range of dependent variables: armament increases, alliance formation, war termination, and foreign conflict. The substantive importance of variables such as these for policy formulators is apparent.

However, at some point it is desirable to develop a theoretical system that organizes a whole domain of inter-related phenomena. Such a theoretical system encompasses and delineates diverse variables, and in so doing must be more abstract in its formulation and conceptualization than the specific variables of particular substantive concern. Field theory offers an organizing framework for the vast array of aggregate level variables of concern for international relations. Within this structure middle range theories, such as status theory (Galtung, 1964) or Rosenau's "pre-theory" (1969), can be connected to substantive concerns. In this fashion, while field theory is abstract in relation to those hypotheses treating specific variable relationships, its ability to subsume such hypotheses provides a general framework within which such relationships can be developed and structured.[3]

The concepts used in the field theory formulation range from the concrete to the intangible. The entities of analysis are the social units of the system, nation-states. The theoretical statements of field theory deal with the relative position of nations within the abstractly defined attribute space and the position of nation dyads in behavior space. These spaces are defined analytically in terms of linear algebra and operationally delineated through factor analysis, which ascertains the dimensions of attribute and behavioral spaces. The dimensions then define the location

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[3]In Rummel (1970c) an effort is made to analyze several specific hypotheses within the field theory context.

of nations and dyads in the two spaces. These dimensions are the variables of theoretical importance for field theory.

The use of dimensions as variables in international relations theory is unusual although not without precedence. Even though analyses usually treat such concepts as power, development, conflict, stratification, penetration, etc., in terms of single variables or as composite indicators, it was recognized by Wright that these concepts, taken together, can be depicted within a multidimensional space. Wright located nations in this space in reference to several dimensions he proposed (Wright, 1955). The existence of a multidimensional space has subsequently been verified in a number of cross-national analyses, which have established rather stable descriptions of the dimensions delineating international relations (e.g., Russett, 1967; Rummel, 1969a).

Important to the social reality described by field theory is the specific theoretical generalization it states relating attribute and behavior spaces. This generalization of field theory is comparable to the many formulations in international relations which link the characteristics of nations to their international behavior. Field theory specifies that the location of a dyad on a dimension of behavior space is determined by the distance vectors that connect nations in attribute space. Mathematically this linkage may be expressed

$$w_{i\text{-}j,k} = \sum_{i=1}^{p} a_i d_{i,i\text{-}j}$$

where w_k is the kth dimension of behavior space and i-j is a particular dyad, with nation i acting toward nation j. That is, international behavior is the consequence of relative differences between nations on their attributes. This particular expression of the linkage between attribute and behavior

spaces has been subsequently called Model I of field theory. An alternative, Model II, has also been proposed. Instead of proposing a general equation over all nation pairs, in Model II the linkage is specific to the particular actor nation i. The mathematical expression of this model is

$$v_{i-j,k} = \sum_{t=1}^{p} a_{it} d_{t,i-j}$$

where the parameter a_{it} is specific to actor nation i. Although the substantive interpretations of these two models are quite different (see Rummel, 1969b, especially pages 31-32), they view similarly the nature of the relationship between attribute and behavior spaces.

In explaining international behavior by the relative attribute characteristics of nations, field theory is an extension of the thinking of several international relations scholars. Building bridges between international behavior and attribute characteristics has been a fairly common pursuit. Examples such as the balance of power and power transition theories, as well as attempts to determine the dependency of such behavioral variables as trade on population (Deutsch, Bliss and Eckstein, 1962), and as foreign conflict on domestic conflict (Tanter, 1966), show the extent to which this question has occupied the interest of students of international relations.

A distinction can be made between those works which treat a nation's total behavior as the result of its attributes and those which predict dyadic behavior in terms of actor-object attribute differences. Representative of the latter type of studies are Wright (1942) positing the probability of war for dyads to be a function of their differences on eight attribute characteristics, Galtung's application of social stratification theory to international conflict (Galtung, 1964; 1966), and Russett's analysis of Anglo-American relationships (1963). In this vein, Model I and Model II of field theory can be considered a more general statement of the relationship between relative attribute characteristics and dyadic international behavior.

II. TESTING FIELD THEORY

As a representation of international relations, field theory has already been subjected to some empirical tests. With the initial presentation of the theory in 1965 only some partial tests were run because of the need for extensive data collection and several preliminary subanalyses (such as that of UN voting). However, data collection and analysis have proceeded to the point where attribute and behavior spaces for one period of time (1955) were defined, enabling a first complete test (Rummel, 1969b) of field theory. Canonical regression analysis was applied to corroborate the predicted fit between attribute distance vectors and behavior dimensions for 1955 data on both a random and a selected sample of dyads. It was found that differences on attribute dimensions accounted for thirteen percent of the variation in behavior when Model I was employed. For Model II an average of fifty-seven percent of the variation in international behavior was accounted for by distances on attributes. A subsequent test of Model II including 1955 data on attribute distances and behavior for eighty-one nation pairs in which the United States was the actor found that nearly fifty percent of the variation in behavior was accounted for by attribute distances (Rummel, 1970c). The results of these tests give some credence to the assumptions of field theory, and point to the greater fit of Model II to empirical data.

The research reported here is a retest of both Model I and Model II of field theory using data from 1963 and employing the same methods applied to the 1955 data. The same selected sample of nation dyads will be used, but the random sample of dyads will be newly selected for 1963. The selected sample provides a basis for assessing the stability of the research findings across the same sample at different time periods and the random sample serves as a benchmark against which the generalizability of the selected sample

results can be assessed. The findings of the 1963 data analysis and a comparison with the results of the earlier study will be presented after considering the methods involved. The tests of Model I will be discussed first and then the Model II results will be presented.

Field theory tests: Model I

The steps in the analysis of Model I for both the 1955 and 1963 data followed the research design displayed in Figure 1. A full explanation of the research methodology is presented in the report on the 1955 data analysis (Rummel, 1969b). A brief outline of the research procedure is given below. Data on attributes of nations and dyadic behavior of nations are separately factor analyzed to delineate the dimensions of attribute and behavior spaces respectively. For attribute space, data on the entire set of nations can be used in determining the dimensions of the space. However, the data collection task makes it prohibitive to include all possible dyads (11,342 for the 1963 data) in the calculation of behavior space dimensions.

In the behavior space analysis data on two samples are analyzed. One sample is that composed of 182 dyads, which are all of the pairings of fourteen selected nations. The other sample contains 166 dyads randomly selected from all possible nation pairs.[4] The factor scores of the individual nations on the attribute space dimensions and of the dyads on the behavior space dimensions are computed for the orthogonally rotated factors. For the selected and random sample dyads, the factor score differences on each attribute dimension are then computed. Canonical regression is then used to determine the fit between these differences (distance vectors) and dyadic scores on the behavior dimension.

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[4]The tests of Models I and II were applied to only the selected sample for 1955 data.

RESEARCH DESIGN FOR FIELD THEORY TESTS

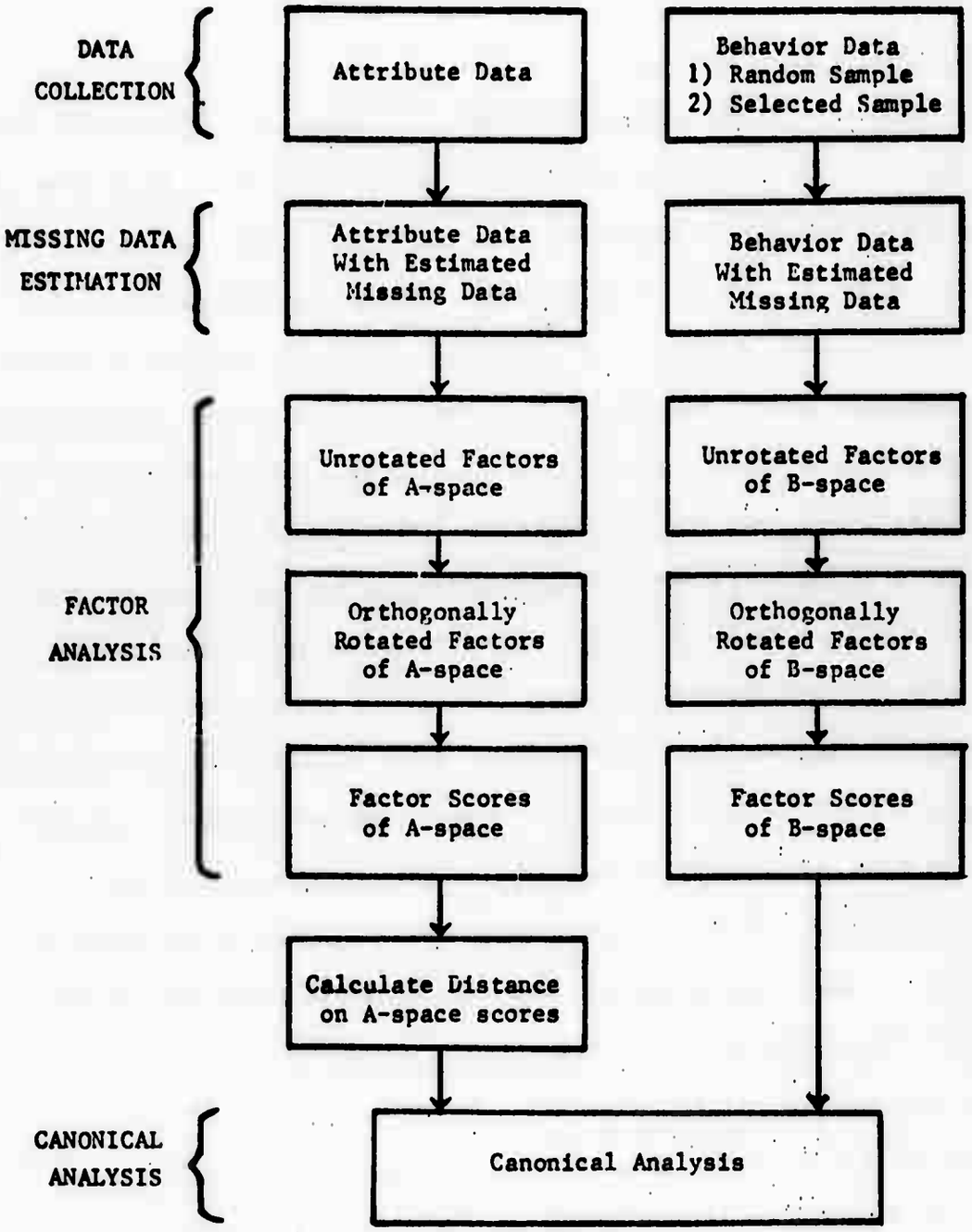

Figure 1

Data: Attribute Distances

The data for the 1963 attribute space was collected for 107 nations on ninety-four variables. These nations comprised all countries having a foreign ministry, exchanging ambassadors with other nations, and containing a population over 750,000, and having been independent for two years. The procedures for selecting the ninety-four variables were as follows.

(1) Five of the highest and substantively distinctive loading variables were taken from each oblique factor found in 1955 data for 236 variables.

(2) Ten of the variables with the lowest communalities and not otherwise selected by (1) above were included. Any change in the common and unique components of attribute space from 1955 to 1963 can thus be observed.

(3) Eight political variables rescaled from Banks and Textor, Cross Polity Survey, and three United Nations voting variables were included to give a better definition to the political dimensions found in 1955 data.

Missing data for the attribute variables was estimated using a multiple regression technique (Wall and Rummel, 1969). A component factor analysis was done on the complete matrix and twenty-two dimensions were orthogonally rotated using the varimax technique.[5] Table 1 summarizes these dimensions, most of which are similar to those found for 1955. For these 1963 dimensions factor scores were computed and differences (distance vectors) were calculated for those nations in the random and selected samples.[6]

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[5]All dimensions for which the eigenvalue exceeded 1.00 were rotated. A factor analysis of the initial data matrix with missing data delineated twenty-two factors for which the eigenvalue exceeded this value. Although the reanalysis of the data with missing data estimated produced twenty-four factors which had eigenvalues exceeding 1.00, it was decided to rotate the same number as appeared in the missing data analysis.

[6]For the test of field theory using 1955 data, attribute distances were calculated on indicator variables of the dimensions of attribute space. The use of these indicators was due to the lack of a missing data estimation program which would have enabled the calculation of factor scores. For a list of the 1955 dimensions and indicators used in the 1955 field theory tests, see Rummel (1969b).

TABLE 1

1963 Attribute Space:
Orthongonally Rotated (Varimax) Dimensions for 94 Variables

Variable name	Loading
Factor 1 - Economic Development[a]	
% total variation = 10.3	
1. agricultural population/population	.85
2. gross national product/population	.85
3. bureaucratic[c]	.82
4. telephones/population	.80
5. dwellings with running water/dwellings	.80
Factor 2 - Political Orientation	
% total variance = 9.8	
1. constitutional status[c]	-.86
2. bloc membership (0 = Western, 1 = Neutral, 2 = Eastern)	-.79
3. system style[c]	.79
4. Communist party membership/population	.75
5. Russian titles translated/titles translated	.75
Factor 3 - Power	
% total variance = 7.8	
1. defense expenditure	.95
2. national income	.94
3. investment balance	.93
4. demonstrations	.93
5. UN assessment/total UN assessment	.92
Factor 4 - Catholic Culture	
% total variance = 5.5	
1. latitudinal measure of nation's capital	.87
2. Catholic population/population	-.80
3. air distance from U.S.	.69
4. factor scores on Cold War Issue Dimension of UN Voting[b]	.52
5. membership in Neutral bloc (yes = 1, no = 0)	.52

[a] Signs reversed.
[b] From Pratt and Rummel (1969).
[c] From Banks and Textor (1963).

TABLE 1 (continued)

Variable name	Loading
Factor 5 - Domestic Conflict[a]	
% total variance = 4.4	
1. population	.90
2. number of riots	.84
3. number of accusations	.78
4. population X energy production	.66
5. number of foreign killed	.63
Factor 6 - Linguistic-Ethnic Diversity[a]	
% total variance = 3.7	
1. number of languages	.75
2. population of largest language group/population	-.75
3. number of religions	.59
4. number of ethnic groups	.51
5. age of nation	.47
Factor 7 - Density	
% total variance = 4.1	
1. density	.80
2. railroad length/national area	.68
3. arable land/total land area	.67
4. foreign mail sent/foreign mail	.58
5. road length/national area	.56
Factor 8 - Trade	
% total variance = 2.6	
1. exports/gross national product	.83
2. seaborne goods/gross national product	.59
3. imports/trade	.51
Factor 9 - Unlabelled	
% total variance = 2.9	
1. cost of living index	.91
2. balance of payments/gold stock	-.84
3. % increase in national income/% increase in population	.64

TABLE 1 (continued)

Variable name	Loading
Factor 10 - Unlabelled	
% total variance = 2.2	
1. arts and culture NGO/total NGO/d	-.71
2. average rainfall	.69
Factor 11 - Military	
% total variance = 2.3	
1. military personnel/population	.71
2. number of military actions	.61
Factor 12 - Unlabelled	
% total variance = 3.1	
1. foreign college students/college students	.78
2. radial measure of geographic location of nation's capital	.64
Factor 13 - Unlabelled	
% total variance = 2.1	
1. factor scores on South African Issue Dimension of UN Voting/b	.86
2. number of purges	.74
Factor 14 - Unlabelled/a	
% total variance = 2.2	
1. number of purges	.74
2. desire for achievement	.51
Factor 15 - Unlabelled	
% total variance = 2.2	
1. legality of government change	.84
2. participation of military in government/c	-.55
Factor 16 - Unlabelled /a	
% total variance = 1.8	
1. IFC and IBRD subscription/GNP^2 per capita	.63

/dNGO = nonintergovernmental organizations

TABLE 1 (continued)

Variable name	Loading
Factor 17 - Unlabelled	
% total variance = 2.1	
1.desire for affiliation	.69
2.proteins/calories	.64
Factor 18 - Unlabelled/a	
% total variance = 2.0	
1. unemployed/economically active population	.72
2. military treaties/treaties	.58
Factor 19 - Unlabelled	
% total variance = 1.7	
1. number killed in domestic violence	.77
Factor 20 - Unlabelled/a	
% total variance = 1.8	
1. balance of investment/gold stock	.80
Factor 21 - Unlabelled/a	
% total variance = 1.6	
1. religious titles published/ book titles	.63
Factor 22 - Unlabelled/a	
% total variance = 2.2	
1. UN delinquencies/assessments	.76
2. national area	.59

One difference between the 1955 and 1963 attribute spaces should be mentioned. The 1955 attribute space did not include geographic location. Accordingly, in the tests of field theory a geographic distance variable was added to the set of distances on the indicators of the 1955 attribute dimensions. For 1963, however, geographic variables locating a nation's capital were included among the ninety-four attribute variables factor analyzed. The dimensions of the 1963 attribute space subsume geographic location and the distances between nations on these dimensions capture geographic distance. Therefore, no separate geographic distance variable need to be included in the 1963 field theory tests.

Data: Behavior Scores

As mentioned above, the data on the behavior of dyads was collected on two dyadic samples. One of these was a selected sample of 182 dyads comprising all possible couplings of fourteen selected nations (excluding, of course, the nation with itself). The fourteen nations were selected to represent high, middle, and low values on the major dimensions found to define the 1955 attribute space and to reflect the major cultural and regional groupings of nations (Cattell, 1950; and Russett, 1967).

The selected list of dyads insures that the full scope of differences and similarities among nations will be analyzed as they relate to interaction between nations. The nations included in the selected sample dyads are: Brazil, Burma, China, Cuba, Egypt, India, Indonesia, Israel, Jordan, Netherlands, Poland, the U.S.S.R., the U.K., and the U.S.A.

To determine the 1963 dyadic random sample, all 107 sovereign nations that had been independent prior to January 1962 were numbered. Eighty dyads of nations then were selected using a random number table. Due to substantive interest, three dyads, US→USSR, USSR→China, and US→France, were added to the

sample. Since two directions of relationship, i→j and j→i are considered for each pair i-j, the sample includes 166 dyadic relations out of a population of 11,342 such relationships for 1963. The random sample dyads are listed in Appendix I.

Forty behavior variables had been included in the analysis of behavior space for 1955.[7] The number of variables for the 1963 analysis was enlarged to fifty-six, adding some variables, such as economic aid, official visits, and co-participation in international conferences, for which 1963 data had become available.[8] The factor analysis of the 1963 behavior data for the selected sample of dyads delineated sixteen factors; for the random sample thirteen dimensions were defined. Factor scores were then calculated for both data sets on the orthogonally rotated dimensions. Table 2 presents the behavioral dimensions for the selected sample. Since those for the random sample are similar,[9] they are not presented here.

Analysis: The Canonical Regression Model

The aspect of field theory that is tested is the proposition linking attribute distances and behavior. This linkage for Model I is $W_{i\to j,k} =$

[7]These variables were selected to index the diversity of interaction between nations, including mail exports, tourists, students, UN voting, conflict, etc. For the 1955 component factor analysis results, see Rummel (1969a).

[8]For the variable definition and 1963 data sources as well as the presentation of the behavior space dimensions, see Rummel (1970a, Appendix I). Missing data was estimated for the 1963 behavioral data, as it was for this data in 1955.

[9]The trace correlation (using canonical analysis) between the random and selected samples is .77. The least squares estimates of the selected sample 1963 behavior dimensions from the 1955 dimensions have a correlation of .84 with the 1963 dimensions; the corresponding correlation for the factor scores is .60. See Rummel (1970a). These results indicate that while the dimensions were fairly stable between 1955 and 1963, the behavior dyads (as measured by the factor scores) shifted considerably. It is of interest to see, then, whether the field theory tests come out the same given that the behavior of dyads has changed so.

TABLE 2

1963 Behavior Space:
Selected Sample Orthogonally Rotated (Varimax) Dimensions*

Variable name	Loading
Factor 1 - Salience	
% total variance = 11.1	
1. export of books and magazines	.87
2. tourists	.87
3. exports	.83
4. military treaties	.73
5. coparticipations in internation conferences	.71
Factor 2 - Cold War[a]	
% total variance = 6.3	
1. common bloc membership[b]	.87
2. bloc position index	-.86
3. similarity in UN Voting on Procedural Issue Dimension	.81
4. weighted similarity in UN Voting on Major Issue Dimensions[c]	.80
Factor 3 - Diplomatic	
% total variance = 4.1	
1. relative diplomatic representation[d]	.91
2. embassy or legation i→j	.78
3. relative diplomats sent[d]	.63
Factor 4 - Deterrence I	
% total variance = 6.9	
1. conflict incidents	.89
2. total conflict	.87
3. negative communications	.86
4. time since on opposite side in war	.66
5. military violence	.56
Factor 5 - International Organization	
% total variance = 8.1	
1. weighted relative IGO[e,f]	.88
2. relative IGO[g]	.86

*Footnotes follow Table 2.

TABLE 2 (continued)

Variable name	Loading
3. weighted relative NGO/h	.83
4. relative NGO/i	.82
5. IGO/i	.64
Factor 6 - Migrants/i	
% total variance = 5.6	
1. emigrants/population	.91
2 relative books exported	.81
3 emigrants	.78
4 relative emigrants	.63
Factor 7 - Unlabelled	
% total variance = 3.7	
1 independence of i and j predates 1946	.84
2 time since on same side in war	.78
Factor 8 - Aid/i	
% total variance = 3.6	
1 economic aid	.93
2 relative economic aid	.92
Factor 9 - Exports/i	
% total variance = 6.0	
1 relative exports	.86
2 largest commodity export/exports A-B	.85
3 export/GNP	.80
Factor 10 - Unlabelled/i	
% total variance = 2.9	
1. territory of i lost to j and not regained	.85
2. book translations	.53
Factor 11 - Deterrence II	
% total variance = 3.6	
1. warning and defensive acts	.80
2. military violence	.59

TABLE 2 (continued)

Variable name	Loading
Factor 12 - Unlabelled[a]	
% total variance = 2.9	
1. i once a colony or part of j	.84
2. relative students i→j	.53
Factor 13 - Military Treaties[a]	
% total variance = 3.3	
1. relative military treaties	.79
2. book translations	.50
Factor 14 - Students	
% total variance = 5.8	
1. students i→j	.86
2. official visits	.73
3. relative treaties	.63
4. treaties	.60
Factor 15 - UN Voting	
% total variance = 4.8	
1. similarity in UN Voting on Major Issue Dimensions[a]	.78
2. similarity in UN Voting on South African Issue Dimension	.73
3. relative NGO[a,d]	-.51
Factor 16 - Negative Sanctions	
% total variance = 2.8	
1. negative sanctions	.63
2. anti-foreign violence	.61

Footnotes to Table 2

/a Signs reversed.

/b Bloc position i j is measured as the absolute difference of position between nation i and j on the following scale

1	2	4	6	7
USA	Non-USA Western Bloc Member	Neutral	Non-USSR Communist Bloc member	USSR

/c Similarity in roll call voting of i and j on six dimensions of UN voting, where each dimension is weighted by the variance in roll call votes for which it accounts.

/d Relative means that the behavior i→j is divided by i's total behavior.

/e IGO comemberships = intergovernmental international organization co-memberships.

/f Co-memberships are relative to the number of IGO's of which i is a member and are weighted to give more weight to small IGO.

/g Same as footnotes e and f, except unweighted.

/h NGO comemberships = nonintergovernmental international organization co-memberships. Otherwise same as footnote f.

/i Same as footnote h, except unweighted.

/j Similarity in roll call voting of i and j on six dimensions of UN voting.

/k See footnote h for definition of NGO.

$\sum_{\ell=1}^{p} \alpha_\ell d_{\ell,i-j}$, which can be given the matrix representation (Rummel, 1969b)

$$W_{mxq} = D_{mxp} P_{pxq}, \tag{1}$$

where W is a matrix of m dyads by q behavioral dimensions (an element w of the matrix is the score for a dyad i→j on behavior dimension k), D is a matrix of distance vectors (a typical element of which $d_{i-j,\ell}$, the distance between nations i and j on the ℓth attribute dimension), P is a matrix of parameters α_ℓ.

Equation (1) states that international behavior is a linear transformation of the attribute distances between two nations. One criteria on which the statement can be assessed is the degree to which it represents our observations. Regressions analysis has been derived within field theory (Rummel, 1969b) as a means toward this assessment. An estimate of the behavior, W, can be obtained using the equation:

$$\begin{aligned} W &= DP + U, \\ W^* &= DP, \end{aligned} \tag{2}$$

and $U = W - W^*$ is the matrix of linear deviations between the estimated behavior W^*, obtained from observations D and parameters P, and the actual behavior W. Assuming the deviations U are uncorrelated by column with D, then

$$\begin{aligned} D'W &= D'DP + D'U \qquad (D'U = 0) \\ (D'D)^{-1}D'W &= P \end{aligned} \tag{3}$$

The parameters P will be regression coefficients and W^* will be the least squares estimate of W.

The square of the trace correlation, $\bar{r}$, is the appropriate statistic to assess the empirical fit between the actual behavior space, W, and that predicted from the attribute distance, W^*. The equation for the trace correlation squared for this data is

$$\overline{r^2} = \frac{1}{q} \sum_{k=1}^{q} \left(\frac{1}{m} W'_k W^*_k \right)^2 = \frac{1}{q} \sum_{k=1}^{q} R_k^2, \qquad (4)$$

where W_k is assumed standardized and R_k is the multiple correlation coefficient for the regression of W_k onto D and the W_k dimensions are mutually orthogonal. The coefficient $\overline{r^2}$ measures the proportion of variance in behavior space accounted for by attribute distances.

The trace correlation can be calculated using any rotation of the dimensions of behavior space, since the variation within the space is not altered by rotating its coordinates. It is possible then to perform a linear transformation of W that will yield orthogonal behavioral dimensions ordered such that the first will have the maximum correlation with D, the second dimension will have the maximum residual correlation, etc. This can be done by applying canonical analysis to solve for the least squares fit between W and D. Let T be the appropriate transformation for W. Then, the canonical model is

$$\begin{aligned} WT &= DP + G, \\ Y &= V + G, \end{aligned} \qquad (5)$$

where WT = Y, DP = V, and G is the least squares error. The restrictions on Y and V are:

$$\begin{aligned} &Y_k'V_g = r_{kg} \quad \text{(canonical correlation)}, \; k = g; \\ &Y_k'V_g = 0, \; k \neq g; \\ &Y_k'Y_k = V'_g V_g = 1; \\ &Y_k'Y_g = V_k'V_g = 0. \end{aligned} \qquad (6)$$

The canonical analysis, then, will yield the least squares fit between attribute distances and behavior dimensions, such that the rotated dimensions Y of behavior successively have the maximum correlations with attribute differences. The trace correlation is unaltered by using the canonical

model and can be calculated from the canonical results by replacing R_K^2 by r_k^2, the canonical correlation, in equation (4).

Analysis: Results of Canonical Regression

Canonical analysis was done with the 1963 data on attribute differences and behavior scores for both the random and selected samples. Similar analyses were done previously for the selected sample on the 1955 data as reported in Rummel (1969b). The results of these canonical regressions are summarized in Table 3 for the 1955 study, Table 4 for the 1963 analysis using the selected sample, and Table 5 for the 1963 analysis using the random sample. The trace correlations obtained for the 1955 data was .36 for the selected sample. The square of this coefficient shows that only thirteen percent of the variation of behavior within behavior space is dependent upon attribute distances. For the 1963 selected sample data, the trace correlation again is .36 and for the random sample the trace is .34. As with the results of the test of Model I using 1955 data, the retests with data for 1963 indicates a lack of fit with empirical data.

It is important to note that in the 1955 selected sample test there were twelve dimensions and sixteen in the 1963 tests. Thus, for 1963 there were many more bits of information for canonical analysis to fit together to achieve a maximum correlation. Taking the different sizes of the two spaces into account, then, how do we compare them?

The transformation column in the tables measures the significance of the canonical correlations in terms of the dimensionality of the spaces. For 1955, we can see that the first canonical correlation is highly significant ($p < .0000003$) and the second is significant at $p \leq .02$ (one tailed).[10]

[10]The one tailed test is appropriate, since field theory predicts that the Z transformation be positive.

TABLE 3

Canonical Analysis Results[a] for Model I

Behavior Dimension Y_k [b]	Canonical Correlation with V_g (k=g)[d]	Chi-square[e]	Degrees of Freedom (D.F.)[f]	Z-transformation for D.F. ≥ 30
Y_1	.79 (.63)	355.3	180	7.71
Y_2	.63 (.40)	190.4	154	2.00
Y_3	.50 (.25)	105.6	130	-1.56
Y_4	.38 (.15)	58.0	108	-3.89
Y_5	.30 (.09)	31.7	88	-5.27
Y_6	.20 (.04)	15.5	70	-6.22
Y_7	.15 (.02)	8.5	54	-6.22
Y_8	.12 (.01)	4.7	40	-5.81
Y_9	.08 (.01)	2.3	28	
Y_{10}	.07 (.01)	1.1	18	
Y_{11}	.03 (.001)	.2	10	
Y_{12}[c]	.01 (.000)	.03	4	

Trace Correlation[h] = .36 (.13)

[a] Minimization of U in Equation (5) under restrictions (6) given in text.

[b] Y_k is a column vector from Y, Y = WT, where W is the matrix of scores on behavior dimensions of B-space and T is a transformation matrix.

[c] A twelfth dimension of W was included in the canonical analysis. Since this dimension involved four variables which are not behavioral (in the sense of action), it is not discussed in the text.

[d] V_g is a column vector from V, V = DP, where D is composed of distance vectors on thirteen indicators of attribute dimensions and two measures of geographic distance (capitol distance and territorial distance). Canonical correlations squared given in parentheses.

[e] The Chi-square equals $-[n-0.5(p+q+1)] \log_e \Lambda$, where n = number of dyads, q = the number of behavioral dimensions of W, p = the number of columns of D, and

$$\Lambda = \prod_{k=1}^{q} (1 - r_k^2)$$

where r_k^2 is the kth squared canonical correlation.

[f] The degrees of freedom = $[p - (k-1)]\ [q - (k-1)]$.

[g] The Z transformation is for reference to corresponding areas under the normal curve.

[h] Trace correlation is $(\sum_{k=1}^{q} r_k^2 / g)^{\frac{1}{2}}$, where r_k^2 is the kth squared canonical correlation and g the number of behavioral dimensions of W.

TABLE 4

Canonical Analysis Results for Model I
1963 - Selected Sample[a]

Behavior Dimension Y_k	Canonical Correlation with V_g (k=g)	Chi-square	Degrees of Freedom (D.F.)	Z-transformation for D.F. $\geq$ 30
Y_1	.70 (.49)	393.37	352	1.53
Y_2	.64 (.41)	282.14	315	-1.33
Y_3	.49 (.24)	198.07	280	-3.74
Y_4	.43 (.18)	153.25	247	-4.70
Y_5	.89 (.15)	119.58	216	-5.30
Y_6	.33 (.11)	92.30	187	-5.73
Y_7	.30 (.09)	73.18	160	-5.76
Y_8	.27 (.07)	57.62	135	-5.67
Y_9	.26 (.07)	45.13	112	-5.43
Y_{10}	.25 (.06)	33.97	91	-5.21
Y_{11}	.20 (.04)	23.59	72	-5.09
Y_{12}	.20 (.04)	16.73	55	-4.66
Y_{13}	.18 (.03)	9.90	40	-4.44
Y_{14}	.14 (.02)	4.85	27	
Y_{15}	.08 (.01)	1.74	16	
Y_{16}	.07 (.00)	0.79	7	

Trace Correlation = .36 (.13)

[a] See footnotes to Table 3.

TABLE 5

Canonical Analysis Results for Model I
1963 - Random Sample[a]

Behavior Dimension Y_k	Canonical Correlation with V_g (k=g)	Chi-square	Degrees of Freedom (D.F.)	Z-transformation for D.F. $\geq$ 30
Y_1	.75 (.56)	274.87	286	-0.45
Y_2	.59 (.34)	152.18	252	-4.98
Y_3	.46 (.21)	89.07	220	-7.61
Y_4	.38 (.14)	53.79	190	-9.10
Y_5	.33 (.11)	31.35	162	-10.05
Y_6	.19 (.04)	14.63	136	-11.05
Y_7	.17 (.03)	9.25	112	-10.63
Y_8	.12 (.01)	4.82	90	-10.27
Y_9	.09 (.01)	2.59	70	-9.51
Y_{10}	.07 (.00)	1.41	52	-8.47
Y_{11}	.06 (.00)	.69	36	-7.25
Y_{12}	.03 (.00)	.21	22	
Y_{13}	.02 (.00)	.07	10	

Trace Correlation = .34 (.12)

[a] See footnotes to Table 3.

Because of this significance, the first canonical variates were given an interpretation and discussed.

For the 1963 Model I selected sample results, however, the significance of the first canonical correlation is $p \leq .07$, while for the random sample the corresponding Z transformation indicates pure chance results.[11] Therefore, we must conclude that although the trace correlation is as high for 1963 as for the 1955 test, this is due to the greater variance included in the 1963 analysis: the 1963 test suggests that Model I does not fit the data at all and that little confidence could be placed in any interpretation of the canonical variates.

Field Theory Tests: Model II

In Model II of field theory the linkage between attribute distances and behavior is expressed by the equation

$$''_{i \to j,k} = \sum_{\ell=1}^{p} a_{i\ell} d_{\ell,i-j}.$$

Replacing the coefficient a_ℓ of Model I with $a_{i\ell}$ of Model II relieves the field theory linkage of a severe constraint. In Model II, as opposed to Model I, it is not assumed that the forces linking attribute differences to behavior act uniformly across all actors. Model II does imply, however, that the forces operating for a particular actor are consistent across all of its dyadic linkages. Furthermore, Model II allows for symmetric, asymmetric and antisymmetric behavior, whereas for Model I the behavior of

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[11] For several of the canonical results, the negative Z transformations are highly significant in Tables 3-5. This indicates that there is some systematic (non chance) reason for these low canonical correlations. Our guess is that the cause of these low correlations is the nature of Model I, which assumes that the i→j behavior on the kth dimension will be of equal magnitude but opposite in sign to j→i behavior. That is, behavior is anti-symmetrical.

nation i to nation j is constrained to be the exact opposite of the behavior of j to i (Rummel, 1969b, p. 32).

The analysis of Model II follows the design presented previously for Model I. The data on attribute distances and behavior dimensions for the selected sample of dyads were separated into fourteen subsamples such that the actor is the same nation for all of the dyads in the subsample. The attribute difference values and the behavior dimension scores are the same values for the dyads as used in the Model I tests. However, due to the small sample size for each Model II subsample (13 dyads) it was necessary to reduce the number of variables (dimensions) for both attribute and behavior space. Consequently, as for the 1955 data, Model II tests, only four attribute difference variables and three behavior variables were employed.

Data: Attribute Distances

Attribute distance variables for the 1955 tests of Model II were selected to represent the three dimensions accounting for the greatest amount of variance in attribute space: economic development, size or power capability, and political orientation. Together these dimensions accounted for forty-one percent of the total variation in the 236 attributes. The indicators employed for these dimensions were respectively energy consumption per capita, national income, and freedom of group opposition. The differences on these indicators were used for the Model II test along with an indicator of geographic distance (the closest geographic distance between the political territories of nations i and j). For the 1963 Model II tests, the variables on which attribute differences were calculated are the factor scores for the four factors of attribute space: economic development, power capability, political orientation, and catholic

culture. The first three dimensions are very similar to the dimensions for which indicators were developed in the study of 1955 data. The fourth dimension, besides accounting for the next greatest amount of variance, also includes geographic location measures as high loading variables.

Data: Behavior Scores

To reduce the number of behavior variables to be analyzed the orthogonal dimensions of behavior space are summed to form a smaller number of orthogonal dimensions. A substantive interpretation of the dimensions delineated in the factor analyses of behavior variables classifies these dimensions into three categories: private international relations, administrative behavior, and conflict behavior. Table 6 shows the dimensions making up each of these three categories of international behavior. The signs above the dimensions indicate whether they were summed or subtracted[12] to form the composite three dimensions. Scores on these three orthogonal dimensions for each of the fourteen subsamples of thirteen dyads each constitute the behavior data for the Model II field theory tests.

Analysis: Results of Canonical Regression

The canonical regression for each of the subsamples of dyads fits a four dimensional subspace of the original attribute space to a three dimensional subspace of the original behavior space. The results of these canonical analyses, summarized in Table 7 for the analyses of 1963 data, may be compared with the results from the study using 1955 data. For the purpose of comparison the results of the canonical analysis of Model II using 1955 data are reproduced here from Rummel (1969b) as Table 8.

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[12]Whether the dimension was summed or subtracted depended on the sign of the loadings on the dimension.

TABLE 6

Behavior Dimensions for
Model II Analysis with 1963 Data

I. Private International Relations

Behavior	+ Salience	- Exports	+ Students	- Migrants
Export of books	.88			
Tourists	.87			
Exports	.83			
Military treaties	.73			
Coparticipation	.71			
Relative exports		-.86		
Largest commodity		-.85		
Export/GNP		-.80		
Students			.86	
Official visits			.73	
Relative treaties			.63	
Treaties			.60	
Emigrant/population				-.91
Relative books				-.81
Emigrants				-.78
Relative emigrants				-.63

II. Administrative Behavior

Behavior	+ Diplomatic	- International Organization	- Aid	- Military Treaties
Relative embassy or legation	.91			
Embassy or legation	.78			
Relative diplomats sent	.63			
N-IGOS		-.88		
Relative IGO		-.86		
N-NGOs		-.83		
Relative NGOs		-.82		
IGOs		-.64		
Economic aid			-.93	
Relative economic aid			-.92	
Relative military treaties				-.79
Book translations				-.50

TABLE 6 (continued)

III. Conflict Behavior

Behavior	- U.N. Voting	+ Cold War	+ Deterrence I	+ Deterrence II	+ Negative Sanctions
UN voting similarity	.78				
South African Issue Dim.	.73				
NGOs	-.51				
Common bloc member		-.87			
Common bloc position		.86			
Procedural Issue Dim.		-.81			
Weighted UN vote similarity		-.80			
Conflict incidence			.89		
Total conflict			.87		
Negative communication			.86		
Time opposite war			.66		
Military violence			.56	.59	
Warning and defense				.80	
Negative sanction					.63
Anti-foreign violence					.61

TABLE 7

Canonical Analysis Results for
Model II - 1963 Data

		Samples[a]												
	Actor	Brazil		Burma		China		Cuba		Egypt		India		Indonesia
	Trace Correlation	.80		.73		.61		.69		.77		.72		.70
	Canonical Correlation	.99	.84	.90	.81	.91	.45	.95	.58	.90	.84	.95	.71	.93 .68
D	Difference on Economic Development			.64						.96				(.43)
D	Difference on Power Capability	-1.04				-.53		-.74	-.71		-.85	-.95		-.87
D	Difference on Political Orientation		-.52		.52	.84			-.94					
D	Difference on Catholic Culture				-.54		-.53						.64	
W	Conflict		.76	.77		.99		.96		.89			.68	.71
W	Administrative Behavior				.92		.66						.61	-.70
W	Private I.R.	.94	-.51	-.64			.63		.94		.88	.99		.92

TABLE 7 (continued)

	Samples[a]													
Actor	Israel		Jordan		Netherlands		Poland		USSR		UNK		US	
Trace Correlation	.73		.78		.74		.79		.65		.67		.79	
Canonical Correlation	.99	.76	.95	.73	.94	.84	.93	.75	.84	.73	.98	.59	.92	.82
D Economic Development		.93												
D Power Capability	-.76	.81	-.87		-.64	(.39)	-.67		-.58	-.79	-.99			-.78
D Political Orientation				(-.46)	.81	(.39)		1.09				.71	1.25	
D Catholic Culture														
W Conflict				.67	-.87		.78		.78				-.84	.71
W Administrative Behavior		.98	.99			.52						.76		
W Private I.R.	.95			.70		-.76	.62	-.84	.53	.92	1.00	-.60		.67

[a] Each sample consists of thirteen dyads comprising the same actor. The actor for each sample is shown heading the canonical results for that sample. Only the first two canonical correlations are shown and only canonical coefficients greater than or equal to an absolute value of .50 (with exception of Egypt's second canonical variate) are given.

TABLE 8

Canonical Analysis
Model II - 1955 Data

Samples [a]

Actor		Brazil		Burma		China		Cuba		Egypt		India		Indonesia	
Trace Correlation		.74		.67		.77		.76		.77		.73.		.65	
Canonical Correlation		.98	.78	.97	.66	.97	.85	1.00	.80	.95	.78	.93	.82	.84	.73
D	Energy Consump. per capita			-.73	-.51				1.00	-1.08	.71		-1.39		-.30
D	National Income	-1.08	-.77			-.75		.96		.67		.54	.64		
D	Freedom of Group Opposition						.78								-.30
D	Territorial Distance		.81	1.18			-.56		-1.40	.81	.60	-.62		.83	-.35
W	Conflict		.73	.84		1.00			- .80			-.57		.88	
W	Administrative Behavior		-.64		.89		.59		.60	.83		-.52			.70
W	Private I.R.	.99					.76	-1.00			-.97	.63	.97		.71

TABLE 8 (continued)

Samples[a]

Actor		Israel		Jordan		Netherlands		Poland		USSR		UNK		US	
Trace Correlation		.80		.71		.63		.69		.77		.75		.75	
Canonical Correlation		1.00	.80	.93	.72	.93	.49	.88	.74	.95	.80	.96	.82	.95	.83
D	Energy Consump. per capita	.57	-1.22		-.65	.87	.56	-.56	-1.92				.76		-.85
D	National Income	.49	1.45	-1.31	.56		-1.25		1.13	-.81		-.75	-.94	-.65	
D	Freedom of Group Opposition				-.78	.62	.51				.78		1.08	.57	
D	Territorial Distance			- .80			- .66	-.60	.83						
W	Conflict			.53					.70	.99			.82	.87	
W	Administrative Behavior		.87	.62	.84	-.69	- .70		.71				-.50		
W	Private I.R.	-.97		.58		-.72	.71	.92			.89	.97			.99

[a] Each sample consists of thirteen dyads comprising the same actor. The actor for each sample is shown heading the canonical results for that sample. Only the first two canonical correlations are shown and only the canonical coefficients greater or equal to an absolute value of .50 (with the exception of Indonesia's second canonical variate) are given.

The square of the trace correlations across all of the subsamples for the 1963 data averages .53 compared to .57 for the 1955 data. The trace correlations range from .61 to .80 for the 1963 studies, compared to a range of .63 to .80 for 1955. While for the 1963 data the average of the first canonical correlation is .93, the average for the 1955 data was .96. Thus, as for the initial analysis of Model II, the retest with attribute and behavior data for 1963 shows a substantial fit of the two spaces. On the average over fifty percent of the variance in behavior space can be accounted for by attribute distances when Model II is employed.

While the trace correlations are quite high for all of the subsamples, it is of interest to note that the composition of the canonical variates varies greatly from 1955 to 1963 for the same subsample of dyads. For example, from the 1955 results it could be stated that the less power China has than an object nation the more conflict behavior it directs toward the object nation. However, for the 1963 data the conflict between China and the object nation is predicted mostly by the closeness of the object to China on political orientation. The change in the makeup of this relationship between attribute distances and behavior reflects the shift in Chinese conflict behavior from the United States and other Western nations to the U.S.S.R. and East Europe. A prevalent finding for the 1963 data is the prediction of private international relations from the negative difference on power. This relationship is found for the actors India, Indonesia, Egypt, Brazil, Israel, the U.S.S.R., and the U.K. The more powerful a nation was than these nations the more private international relations they directed toward them. In the earlier study this particular relationship was found for the Brazil, the U.K., and Cuba subsamples.

That there is so little stability in the coefficients depicting the dependencies between attribute differences and behavior across time periods can be interpreted as indicating that the structure of relationships between

attribute distance vectors and behavior has radically changed. Consonant with this, comparative analyses of the factor structures of international behavior at these two time periods, 1955 and 1963, have noted the shift of particular nations or dyads (Rummel, 1970a). Analyses of conflict behavior show rather dramatic changes in the location of dyads within the conflict subspace between these two periods (Hall and Rummel, 1969). The shifts with which these studies deal are changes in the location of nations or dyads within the same analytically defined subspace at two different points in time. The change noted in this study is in the configuration of attribute distances which predict to a configuration of behaviors. Regardless of this shift, however, the ability of attribute differences per se to explain behavior remains substantially (practically) the same as for 1955.

In order to conduct the Model II analyses, less than half of the variation in the attribute and behavior spaces could be used. Further analyses will be necessary to determine whether the fit of the two spaces will remain as good when more dimensions are included.

Moreover, the particular nations included in the Model II analyses were from a selected sample. Insofar as possible it is desirable to broaden the sample of nations making up the dyads. In line with this, tests have just been concluded (Rummel, 1970c) on the total sample of dyads for the U.S. as actor. Since the test involved 81 dyads for 1955, all the behavioral and attribute dimensions were involved. The trace correlation squared remained above .50, showing only a slight reduction in the fit compared to the analysis reported here. While encouraging, the tests of field theory presented in this paper are still only suggestive. The dynamic properties of the theory are yet untested. The relationship between this theory and other aggregate level propositions is just now beginning to be explored. And many more tests are needed. With the findings reported here in mind, these other tasks will be pursued.

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APPENDIX I

1963 Dyadic Relations Random Sample

All 107 sovereign nations that had been independent prior to January 1962 were numbered. Eighty pairs (dyads) of nations then were selected by consecutive numbers in a random table (page of random numbers and first number used were selected randomly as well).

As with the 1955 study random sample, three dyads, US-USSR, US-France, and USSR-China were added to the sample. Their theoretical value is believed to outweigh the consequent slight loss of randomness.

Since two directions of relationship A→B and B→A are considered for each dyad A - B, the sample of 83 dyads becomes a sample of 166 dyadic relations out of a population of 11,342 such relationships for 1963.

1963 Dyadic Relations Random Sample

II. Nations Included

Nation	Code	Nation	Code
Afganistan	AFG	Jordan	JOR
Albania	ALB	Korea (Dem. Rep.)	KON
Australia	AUL	Korea (Rep. of)	KOS
Austria	AUS	Lebanon	LEB
Belgium	BEL	Liberia	LBR
Bolivia	BOL	Madagascar (Malagasy)	MAD
Brazil	BRA	Malaysia (Malay)	MAL
Bulgaria	BUL	Mali	MLI
Burma	BUR	Mauritania	MAT
Cambodia	CAI	Mexico	MEX
Cameroon	CAO	Morocco	MOR
Canada	CAN	Nepal	NEP
Central African Rep.	CEN	Netherlands	NTH
Chad	CHA	Nicaragua	NIC
Chile	CHL	Niger	NIR
China	CHN	Nigeria	NIG
Rep. of China	CHT	Norway	NOR
Columbia	COL	Panama	PAN
Congo (Brazzaville)	CON	Paraguay	PAR
Congo (Leopoldville)	COP	Peru	PER
Costa Rica	COS	Phillipines	PHL
Czechoslovakia	CZE	Portugal	POR
Dahomey	DAH	Rumania	RUM
Denmark	DEN	Saudi Arabia	SAU
Dominican Republic	DOM	Senegal	SEN
Ecuador	ECU	Sierra Leone	SIE
Egypt	EGP	Spain	SPN
Ethiopia	ETH	Sudan	SUD
Finland	FIN	Sweden	SWD
France	FRN	Switzerland	SWZ
Ghana	GHA	Syria	SYR
Germany (D.D.P.)	GME	Tanganyika	TAN
Germany (Fed. Rep.)	GMW	Thailand	TAI
Greece	GRC	Togo	TOG
Guatamala	CUA	Turkey	TUR
Guinea	GUN	Union of South Africa	UNS
Hungary	HUN	Union of Soviet Socialist Republics	USR
Indonesia	INS	United Kingdom	UNK
Iran	IRN	United States of America	USA
Iraq	IRQ	Upper Volta	UPP
Ireland	IRE	Vietnam (North)	VTN
Israel	ISR	Vietnam (South)	VTS
Italy	ITA	Yemen	YEM
Ivory Coast	IVO	Yugoslavia	YUG
Japan	JAP	Honduras	HON

III. 1963 Dyadic Relations Sample*
(N = 166)

No.	Dyad	Code
1.	Afganistan ⟶ Bolivia	AFG → BOL
2.	Albania ⟶ China	ALB → CHN
3.	Australia ⟶ Denmark	AUL → DEN
4.	" ⟶ Germany (D.D.R.)	AUL → GME
5.	Austria ⟶ Belgium	AUS → BEL
6.	" ⟶ Bulgaria	AUS → BUL
7.	Belgium ⟶ Austria	BEL → AUS
8.	Bolivia ⟶ Afganistan	BOL → AFG
9.	" ⟶ Rumania	BOL → RUM
10.	" ⟶ Togo	BOL → TOG
11.	Brazil ⟶ France	BRA → FRN
12.	" ⟶ Guinea	BRA → GUI
13.	" ⟶ Israel	BRA → ISR
14.	" ⟶ Portugal	BRA → POR
15.	" ⟶ Senegal	BRA → SEN
16.	" ⟶ Togo	BRA → TOG
17.	Bulgaria ⟶ Austria	BUL → AUS
18.	Burma ⟶ Japan	BUR → JAP
19.	Cambodia ⇢ Italy	CAM → ITA
20.	" ⇢ Portugal	CAM → POR
21.	⇢ United States of Am.	CAM → USA
22.	Cameroon ⟶ Congo (Brazzaville)	CAO → CON
23.	" ⟶ Hungary	CAO → HUN
24.	" ⟶ Korea (Rep. of)	CAO → ROS
25.	" ⟶ Peru	CAO → PER
26.	Canada ⟶ Ethiopia	CAN → ETH
27.	Central African Rep. ⟶ Costa Rica	CEN → COS
28.	" ⟶ Rumania	CEN → RUM
29.	Chad ⟶ Columbia	CHA → COL
30.	" ⟶ Switzerland	CHA → SWZ
31.	Chile ⟶ Senegal	CHL → SEN
32.	China ⟶ Albania	CHN → ALB
33.	" ⟶ U.S.S.R.	CHN → USR
34.	Rep. of China ⟶ Turkey	CHT → TUR
35.	Columbia ⟶ Chad	COL → CHA
36.	Congo (Brazzaville) ⟶ Cameroon	CON → CAM
37.	" ⟶ Norway	CON → NOR
38.	" ⟶ Sudan	CON → SUD
39.	" ⟶ Upper Volta	CON → UPP
40.	Congo (Leopoldville) ⟶ Guinea	COP → GUI
41.	" ⟶ Israel	COP → ISR
42.	" ⟶ Jordan	COP → JOR
43.	" ⟶ Vietnam (South)	COP → VTS
44.	Costa Rica ⟶ Central African Rep.	COS → CEN
45.	Czechoslevakia ⟶ Korea (Dem. Rep.)	CZE → KON
46.	" ⟶ Yemen	CZE → YEM
47.	Dahomey ⟶ Union of South Africa	DAH → UNS
48.	Denmark ⟶ Australia	DEN → AUL
49.	Dominican Rep. ⟶ Guinea	DOM → GUN
50.	Ecuador ⟶ Korea (Rep. of)	ECU → KOS
51.	Egypt ⟶ Germany (Fed. Rep.)	EGP → GFR
52.	" ⟶ Malaysia	EGP → MAL
53.	Ethiopia ⟶ Canada	ETH → CAN
54.	" ⟶ Mali	ETH → MLI
55.	" ⟶ Yemen	ETH → YEM
56.	Finland ⟶ Spain	FIN → SPN
57.	France ⟶ Brazil	FRN → BRA
58.	France ⟶ U.S.A.	FRN → USA
59.	Ghana ⟶ Upper Volta	GHA → UPP
60.	Germany (D.D.R) ⟶ Australia	GME → AUL

No.	Dyad			Code
61.	Germany (D.D.R.)	→	Niger	GME → NIR
62.	Germany (Fed. Rep.)	→	Egypt	GMW → EGP
63.	"	→	Upper Volta	GMW → UPP
64.	Greece	→	Iran	GRC → IRN
65.	"	→	Nigeria	GRC → NIG
66.	Guatamala	→	Vietnam (North	GUA → VTN
67.	Guinea	→	Brazil	GUI → BRA
68.	"	→	Congo (Leopoldville)	GUI → COP
69.	"	→	Dominican Republic	GUI → DOM
70.	Hungary	→	Cameroon	HUN → CAO
71.	Indonesia	→	Korea (Dem. Rep.)	INS → KON
72.	Iran	→	Greece	IRN → GRC
73.	"	→	Jordan	IRN → JOR
74.	Iraq	→	Lebanon	IRQ → LEB
75.	"	→	Liberia	IRQ → LBR
76.	Ireland	→	Lebanon	IRE → LEB
77.	"	→	Sweden	IRE → SWD
78.	"	→	Turkey	IRE → TUR
79.	Israel	→	Brazil	ISR → BRA
80.	"	→	Congo (Leopoldville)	ISR → COP
81.	"	→	Mauritania	ISR → MAT
82.	Italy	→	Cambodia	ITA → CAM
83.	Ivory Coast	→	Syria	IVO → SYR
84.	Japan	→	Burma	JAP → BUR
85.	Jordan	→	Congo (Leopoldville)	JOR → COP
86.	"	→	Iran	JOR → IRN
87.	Korea (Dem. Rep.)	→	Czechoslovakia	KON → CZE
88.	"	→	Indonesia	KON → INS
89.	Korea (Rep. of)	→	Cameroon	KOS → CAO
90.	"	→	Ecador	KOS → ECU
91.	"	→	Thailand	KOS → TAI
92.	Lebanon	→	Iraq	LEB → IRQ
93.	"	→	Ireland	LEB → IRE
94.	Liberia	→	Iraq	LBR → IRQ
95.	Madagascar	→	Togo	MAD → TOG
96.	Malaysia	→	Egypt	MAL → EGP
97.	Mali	→	Ethiopia	MLI → ETH
98.	Mauritania	→	Israel	MAT → ISR
99.	Mexico	→	Nigeria	MEX → NIG
100.	Morocco	→	Netherlands	MOR → NTH
101.	Nepal	→	Saudi Arabia	NEP → SAU
102.	"	→	Switzerland	NEP → SWZ
103.	"	→	Yugoslavia	NEP → YUG
104.	Netherlands	→	Morocco	NTH → MOR
105.	Nicaragua	→	U. S. A.	NIC → USA
106.	Niger	→	Germany (D.D.R.)	NIR → GME
107.	Nigeria	→	Greece	NIG → GRC
108.	"	→	Mexico	NIG → MEX
109.	Norway	→	Congo (Brazzaville)	NOR → CON
110.	Panama	→	Tanganyika	PAN → TAN
111.	Paraguay	→	United Kingdom	PAR → UNK
112.	Peru	→	Cameroon	PER → CAO
113.	Philippines	→	Portugal	PHL → POR
114.	"	→	Union of S. Africa	PHL → UNS
115.	Portugal	→	Brazil	POR → BRA
116.	"	→	Cambodia	POR → CAM
117.	"	→	Philippines	POR → PHL
118.	Rumania	→	Bolivia	RUM → BOL
119.	"	→	Central African Rep.	RUM → CEN
120.	"	→	U. S. A.	RUM → USA
121.	Saudi Arabia	→	Nepal	SAU → NEP
122.	Senegal	→	Brazil	SEN → BRA
123.	"	→	Chile	SEN → CHL
124.	Sierra Leone	→	Tanganyika	SIE → TAN
125.	Spain	→	Finland	SPN → FIN
126.	Sudan	→	Congo (Brazzaville)	SUD → CON
127.	Sweden	→	Ireland	SWD → IRE
128.	Switerland	→	Chad	SWZ → CHA
129.	"	→	Nepal	SWZ → NEP
130.	"	→	Vietnam (South)	SWZ → VTS
131.	Syria	→	Ivory Coast	SYR → IVO
132.	Tanganyika	→	Panama	TAN → PAN
133.	"	→	Sierra Leone	TAN → SIE
134.	Thailand	→	Korea (Rep. of)	TAI → KOS
135.	Togo	→	Bolivia	TOG → BOL
136.	"	→	Brazil	TOG → BRA

No.	Dyad		Code	
137.	Togo	Madagascar	TOG	MAD
138.	"	Vietnam (North)	TOG	VTN
139.	Turkey	China (Rep. of)	TUR	CHT
140.	"	Ireland	TUR	IRE
141.	"	Union of S. Africa	TUR	UNS
142.	Union of S. Africa	Dahomey	UNS	DAH
143.	"	Philippines	UNS	PHL
144.	"	Turkey	UNS	TUR
145.	U.S.S.R.	China	USR	CHN
146.	"	U. S. A.	USR	USA
147.	United Kingdom	Paraguay	UNK	PAR
148.	U. S. A.	Cambodia	USA	CAM
149.	"	France	USA	FRN
150.	"	Nicaragua	USA	NIC
151.	"	Rumania	USA	RUM
152.	"	U.S.S.R.	USA	USR
153.	Upper Volta	Congo (Brazzaville)	UPP	CON
154.	"	Germany (Fed. Rep.	UPP	GMW
155.	Upper Volta	Ghana	UPP	GHA
156.	"	Vietnam (North)	UPP	VTN
157.	Vietnam (North)	Guatemala	VTN	GUA
158.	"	Togo	VTN	TOG
159.	"	Upper Volta	VTN	UPP
160.	Vietnam (South)	Congo (Leopoldville)	VTS	COP
161.	"	Switzerland	VTS	SWZ
162.	Yemen	Czechoslovakia	YEM	CZE
163.	"	Ethiopia	YEM	ETH
164.	Yugoslavia	Nepal	YUG	NEP
165.	Honduras	Malaysia	HON	MAL
166.	Malaysia	Honduras	MAL	HON

* The arrow between the members of the dyad indicates the direction of the relationship that is considered. For Example, ARG → CUB symbolizes the behavior of Argentina towards Cuba in such asymmetrical variables as exports, threats, and mail sent.